HY-05 Making soap, lye and disinfectants from ash, fat, salt and sun

HEALING after the FALL, research library, HY-05

Researched 10 October 2026 by Claude Opus agent for THRIVING after the FALL, Book Four. Library document, unverified.

Scope, and what this report does not repeat

This report is for the village dispensary, which needs four products and one skill: a hand soap, a laundry soap, a surface disinfectant, a disinfectant for excreta and soiled cloth, and a way to test their strength. It covers lye from ash, soap, lime, vinegar, hypochlorite (chlorine bleach), and heat, sun and drying.

It points to its neighbours rather than copying them. FEASTING after the FALL gives the household lye barrel, soft soap, bar soap by salting out and the great wash (Chapter 17 and Bench protocols 4 to 6), rendering of tallow and lard (Chapter 9), limewater and quicklime (Chapters 6 and 8) and the cellar whitewash (Chapter 12). FEASTING has no document on burning lime. THRIVING library HY-01 settles whether soap, ash, alcohol rub or 0.05% chlorine prevent disease, and HY-02 covers drinking water. IN-07, not yet written, owns Dakin's solution and wound antiseptics.

Under the series' safety rule, soap, vinegar, boiled water and chlorine diluted from a known bleach are given as recipes. Electrolytic chlorine is treated as a manufactured device with a field record, not a build guide. Lime burning is described from the record, without a kiln procedure.

1. The chemistry in one page

Fat is mostly triglyceride: three fatty acids on one glycerol. A strong alkali splits it into three molecules of soap and one of glycerol. The alkali needed is fixed by the fat and expressed as the saponification (SAP) value, milligrams of potassium hydroxide per gram of fat (Codex 1999a, 1999b). Sodium hydroxide does the same work at 40 parts for every 56.1 of potassium hydroxide.

Wood ash gives potassium mostly as potassium carbonate (potash), a weaker alkali that saponifies slowly and incompletely. Slaked lime added to the wet ash converts it to potassium hydroxide (caustic potash), and the calcium drops out as chalk. This causticising is old: Claude Joseph Geoffroy described the soapboilers' use of freshly burnt lime in the Philosophical Transactions of 1742 (Geoffroy 1742), and the Mappae Clavicula of about 1130 has "a little lime" in its lye (Dunn, Caveman Chemistry). Wood ash itself is 20 to 50% calcium oxide, so ash lye is partly causticised by its own lime (Wikipedia, Wood ash, secondary) [VERIFY].

Lime is calcium carbonate burnt to quicklime (calcium oxide), which with water becomes slaked lime (calcium hydroxide), holding water near pH 12.5 to 13 until it takes carbon dioxide from the air and returns to chalk.

Hypochlorite in water sits as hypochlorous acid (the strong killer) and hypochlorite ion (weaker), balanced by pH. Below about pH 4 it leaves as chlorine gas (Naranjo-Soledad et al. 2024). Blood and dirt use it up (Rutala, Weber and HICPAC 2008). Vinegar is dilute acetic acid. Heat kills by time and temperature, sun by ultraviolet and warmth, drying by removing water.

2. Lye from ash

2.1 Which ash

Tradition and record agree that hardwood ash makes lye and softwood does not. Jefferson's Farm Book says "Neither pine nor chesnut will do" (Jefferson, Farm Book p.117). FEASTING Chapter 17 says pine and spruce (Pinus sylvestris, Picea abies) give a weak, tarry lye, and keeps the beech (Fagus sylvatica) ash of the hearth apart, 50 to 70 kg a year [VERIFY]. Oak (Quercus robur, Q. petraea), maple, ash (Fraxinus excelsior) and, in American sources, hickory (Carya species) are the lye woods. Wood ash holds only about 3 to 10% potassium (Wikipedia, Wood ash, and Forest Research 2022, both secondary).

Banana residue is far richer. Babayemi and colleagues (2010) measured ash from six Nigerian Musa varieties (cultivars of Musa acuminata and Musa × paradisiaca): peel was 6.3 to 12.0% ash by dry weight, and the alkali was 69.0 to 81.9% of the ash, by titration with 0.1 M hydrochloric acid. Practical Action's village soap brief independently names banana leaf and stem ash as giving the strongest lye (Practical Action, Soap making). Babayemi notes the literature is divided on whether such alkali is hydroxide or carbonate, which matters for the arithmetic in 3.2.

The hard soaps of Aleppo, Castile and Marseille used soda (sodium carbonate) from the ash of coastal glasswort and saltwort (Salicornia europaea, Salsola soda), traded as barilla (Wikipedia, Soap, secondary). Geoffroy's lye was made from "glasswort salt" (Geoffroy 1742).

2.2 Yield and labour

Jefferson recorded that a cord of wood gave two bushels of ash, a bushel gave 6 lb of "black salts", and that gave 3 to 5 lb of pearl ash, or 5 lb by Samuel Hopkins's method. A man cut and burnt two and a half cords a day (Jefferson, Farm Book p.117). Hopkins held the first United States patent, of 31 July 1790, for potash and pearl ash (secondary) [VERIFY]. By my arithmetic a cord gives about 2.7 to 4.5 kg of refined potash [VERIFY]. Potash was a cash crop of forest clearance, not a household product.

For the household, FEASTING Chapter 17 gives one bucket of ash to about a quarter of a bucket of lye, rainwater leached through a barrel over straw and stones for one to two days. Practical Action describes the same barrel and filter, with boiling water and 12 to 24 hours' standing. The sources agree on method and differ on time, which depends on water temperature.

2.3 Strength tests

The egg. Geoffroy (1742) gives the soapboilers' test: if half a hen's egg stands above the lye, it is of the first strength. FEASTING gives the household version, a fresh egg floating with a coin-sized patch showing. Lydia Maria Child's American Frugal Housewife (1828) allowed an egg or a potato (secondary) [VERIFY]. Geoffroy named the flaw himself: "all Hens Eggs have not the same specific Gravity". An egg loses water as it ages, so an old egg floats in plain water (secondary) [VERIFY]. The egg measures density, and ash lye's density includes salts that make no soap. It is a go or no-go test, adequate because, as Practical Action says, lye combines with fat in fixed proportion and a weaker lye simply needs more volume.

The feather. A feather dissolving in hot lye shows causticity (FEASTING Chapter 17). Keratin dissolves in hydroxide much more than in carbonate, so this tests for causticising, not strength [VERIFY]. I found no measured account.

Indicators and titration. pH paper at 13 or above shows hydroxide [VERIFY]. Titration against a known acid, as Babayemi et al. (2010) did, is the only test that gives grams of alkali per litre.

The tongue. FEASTING gives a tongue test for soap, which its own VERIFICATIONS table leaves unresolved (row T10). A tongue on lye is a caustic burn. I would remove any tongue test of lye from the book.

Ash lye, much diluted, is also the washerwoman's agent. FEASTING caps lye on cloth at 3% and forbids egg-floating lye on cloth. It is never a hand wash. HY-01 reports an ash filtrate at pH 10.7 (Shithi 2024) and Bangladeshi trials in which dry ash scrubbed hands about as well as soap (Hoque 1991, 1995) (THRIVING library, HY-01).

2.4 The burns

Alkali dissolves tissue and keeps penetrating. Gnaneswaran, Perera, Perera and Sawhney (2015) note that alkali burns can look superficial and become full thickness over 48 to 72 hours, that chemical burns are 3 to 5% of burn admissions, that dry lime should be brushed off before water, and that irrigation should be with copious water, never a neutralising acid, because neutralisation adds heat. Leonard, Scheulen and Munster (1982), in 35 Baltimore patients from 1976 to 1980, found those irrigated at the scene had significantly less full-thickness injury and hospital stays less than half as long (abstract only).

In the eye, speed of first irrigation outweighs everything that follows (Kuckelkorn et al. 2002, abstract only). EyeWiki advises at least 15 to 30 minutes and up to 20 litres. A sodium hydroxide safety sheet asks for at least 20 minutes and warns that pain may be delayed (Hydrite 2022). An Australian series of 159 alkali eye burns found lime the commonest agent (Retrospective study of alkali burns of the eye 1983, search summary only) [VERIFY].

FEASTING's VERIFICATIONS row T1 amended its first aid to water for at least 15 minutes, then vinegar "only after water and only on skin". I disagree with keeping vinegar at all. Gnaneswaran et al. (2015) advise against neutralisation, and a frightened person reaches for whatever the book names first. The rule should be water only, for longer than feels necessary.

2.5 The swallowed lye

The worst harm of home soap-making is the child who drinks the lye. Ekpe and Ette (2012) reported 16 children with caustic ingestion at the University of Uyo Teaching Hospital, Nigeria, November 2006 to November 2010. The agent was caustic soda in 93.7%. In 14 of 16 (87.5%) the mother was making soap at home. Most were one to three years old. Half developed oesophageal stricture, seven needed gastrostomy, and one died. Induced vomiting worsened injury. The authors urged safe storage, community soap-making centres away from homes, and colouring caustic soda.

The National Cardiothoracic Centre in Accra reported 55 surgical cases from 1991 to 1999 and 71 from 2000 to 2006. Of 37 children aged ten or under, 20 were one to three. Caustic soda for soap-making had been stored in soft-drink bottles (Daily Graphic via myjoyonline 2008, secondary). EMERGENCY's paediatric centre at Goderich, Sierra Leone, saw over 140 new patients in 2021, just under 80% under five, treated by three to six dilatations at intervals of 6 to 15 days (EMERGENCY 2022). In Philadelphia a century earlier, Chevalier Jackson's campaign over lye strictures led to the Federal Caustic Poison Act, usually dated 1927, though secondary sources also give 1925 and 1929 (Mütter Museum) [VERIFY].

A village that makes soap at home will recreate this epidemic unless it organises otherwise: lye in a marked container that cannot be taken for a drink, kept high or locked, and soap made in one place by named people.

3. Soap

3.1 From Pliny to Marseille

Pliny the Elder (Natural History XXVIII.li) describes sapo as a Gallic invention for reddening hair, made from suet and ash, best from beech ash and goat suet, used among the Germans more by men than women (quoted in Dunn, Caveman Chemistry). Mesopotamian tablets of the third millennium BC record ash and fat, though not as detergents (Dunn). The popular "Babylonian soap recipe" of 2800 or 2200 BC traces to Martin Levey (1954), which I could not find [VERIFY].

Bar soap needs soda. Aleppo's soap of olive oil (Olea europaea) and laurel oil (Laurus nobilis) is old but undated, with export grades above about 16% laurel (Wikipedia, Aleppo soap, secondary) [VERIFY]. Soap-making centres grew in Marseille by the ninth century, Venice by the fourteenth and Castile by the fifteenth (Dunn). A royal edict of 1688 restricted Marseille soap to olive oil and soda (secondary) [VERIFY]. The "72% oil" rule often quoted I could not trace to the edict. The 1758 Dictionnaire Oeconomique, as Dunn quotes it, distinguishes white solid soap from lime and soda and black liquid soap from lime and potash, which is section 3.3 in one line. Nicolas Leblanc's process for soda from salt, patented in 1791 at Saint-Denis, made industrial bar soap possible (Wikipedia, Nicolas Leblanc, secondary).

British consumption is recorded at about 7 lb per head around 1800, 11 lb in 1846, 8 lb 1 oz in 1850 (Tallis 1851) and 14 lb in 1880 (Grace's Guide). That is 3 to 6 kg a person a year, a benchmark for a village washing at a nineteenth-century standard.

3.2 Saponification values and the arithmetic

Codex SAP values, converted to grams of alkali per kilogram of fat (NaOH = KOH × 0.713):

Fat or oil	SAP, mg KOH/g	Pure KOH, g/kg	Pure NaOH, g/kg	Source
Tallow	190 to 202	190 to 202	135 to 144	Codex 1999b
Lard	192 to 203	192 to 203	137 to 145	Codex 1999b
Olive	184 to 196	184 to 196	131 to 140	Wikipedia [VERIFY]
Rapeseed, low erucic	182 to 193	182 to 193	130 to 138	Codex 1999a
Sunflower	188 to 194	188 to 194	134 to 138	Codex 1999a
Soya	189 to 195	189 to 195	135 to 139	Codex 1999a
Mustard	168 to 184	168 to 184	120 to 131	Codex 1999a
Palm	190 to 209	190 to 209	135 to 149	Codex 1999a
Coconut	248 to 265	248 to 265	177 to 189	Codex 1999a
Palm kernel	230 to 254	230 to 254	164 to 181	Codex 1999a

Three things follow. First, the common European fats need almost the same alkali, and only coconut and palm kernel need about a third more.

Second, FEASTING Chapter 9's 140 g NaOH or 200 g KOH per kilogram of tallow are right for complete saponification and leave no margin. At the low end of tallow's range 140 g is 4% too much, and the bar carries free alkali. Soap-makers "superfat" by using about 5% less. I recommend the book's default be 130 g NaOH or 185 g pure KOH per kilogram of tallow or lard [VERIFY].

Third, I disagree with FEASTING Chapter 17's "200 g potash". FEASTING's own row B19 notes it means pure KOH. Potash (carbonate) supplies about a fifth less potassium per gram (1.23 g of carbonate equals 1 g of KOH), so 200 g of potash is about 20% short, and carbonate saponifies poorly without causticising [VERIFY]. Ash lye can only be measured by egg and volume, or by titration. FEASTING gives 3 to 4 litres of egg-floating lye per kilogram of tallow, and the National Park Service at Fort Scott gives 2 lb of grease per gallon of lye, 4.2 litres per kilogram (NPS Fort Scott). Two sources agree, both resting on the egg. Commercial caustic potash is often about 90% pure, so pure-KOH recipes need about a tenth more of it (forum consensus, secondary) [VERIFY].

3.3 Soft potash soap and hard soda soap

Potassium soaps are soft, translucent pastes. Sodium soaps of the same fats set hard. Ash lye makes soft soap, the Schmierseife of the European household, good for laundry and floors and for hands from a pot.

To make a bar, the soap-boiler added salt to the hot soft soap. Sodium exchanges with potassium, giving a mostly sodium soap and potassium chloride, and the soap separates as curds holding about 30% water, leaving glycerol in the spent lye (Wikipedia, Hard soap, quoting an older encyclopedia, secondary). A South Carolina newspaper of 1841 told readers to add common salt and boil until a ladleful set hard in cold water (USC historic newspapers 1841). FEASTING gives a quarter of the soap's weight in salt. The exchange is never complete, so salted ash-lye soap is softer than a modern bar (forum summaries, secondary).

Plant saponins are not soap. Soapwort (Saponaria officinalis, root and leaf) and soapnut (Sapindus mukorossi, fruit husk) lather but HY-01 graded them D, and both are toxic if swallowed [VERIFY]. Bay laurel (Laurus nobilis) must not be confused with the hedge cherry laurel (Prunus laurocerasus), whose leaves are cyanogenic [VERIFY].

3.4 Cold process, hot process and curing

In the cold process, lye and fat are stirred at modest temperature (FEASTING: tallow at 40 to 45 °C) until the batter thickens ("trace"), then moulded and cured. Geoffroy (1742) described a soap "made without fire" from one part strong lye to two of oil, set in the sun. In the hot process the mix is boiled for hours, which suits weak ash lye. Practical Action gives a simmer of four to six hours (search snippet) [VERIFY], and the Mappae Clavicula worked its soap two to four days (Dunn).

Craft sources demand a cure of four to six weeks. The limited evidence I found says saponification is largely complete in one to three days and that curing is mostly water loss, giving a harder, milder bar (soap-maker sources, secondary) [VERIFY]. A soap that passes the free-alkali test (3.6) can be used after a few days, but lasts longer if cured a month.

3.5 Yield, labour, need and storage

My arithmetic for 1 kg of tallow (molecular weight about 860): about 140 g of sodium hydroxide gives about 1,030 g of dry soap and about 107 g of glycerol [VERIFY]. A cold-process bar keeps the glycerol and 10 to 15% water, about 1.25 to 1.35 kg. A salted soap loses its glycerol and dries to about 1.2 to 1.3 kg. A soft potash soap, perhaps 40 to 50% water, gives about 2 kg [VERIFY]. None of these was measured in a source I read. Weigh the first batches.

Labour: a barrel of ash stands one to two days and needs a few hours of pouring. A cold batch is an hour or two of stirring. A hot or salted batch is a day at the fire.

Need: FEASTING puts a household of four at 10 to 15 kg of soap a year. HY-01 gives the WHO's 0.5 to 2 g of bar soap per handwash. A dispensary with 100 handwashes a day at 1.5 g uses about 55 kg a year, which is about 45 kg of fat before laundry [VERIFY]. That is a substantial share of a village's fat, competing with the kitchen.

Storage: tallow keeps a year and lard six to nine months (FEASTING Chapter 9). Dry hard soap keeps for years. Soap with excess fat goes rancid in months [VERIFY]. Lye in an open vessel absorbs carbon dioxide and weakens [VERIFY]. Never store lye in aluminium.

3.6 Testing the soap

- **Lather and clarity.** A shaving dissolves in warm water and lathers without a greasy film. Grease means too little lye.
- **Phenolphthalein in neutral alcohol.** Pink means free alkali. Titrating it away with dilute acid is the laboratory measure (forum summaries of Dunn, Scientific Soapmaking 2010, secondhand) [VERIFY]. Soap in water is itself pH 9 to 10, so the test must be in alcohol.

- **pH paper.** A 1% solution of sound soap reads about 9 to 10, and above about 11 suggests free lye (secondary, unreliable) [VERIFY].
- **The zap test.** A wetted finger on cured soap touched to the tongue tip: a sting means free alkali (attributed to Dunn, secondhand) [VERIFY]. Cured soap only, never lye or fresh batter. The book should prefer phenolphthalein.

4. Lime

4.1 Quicklime: what the record shows

Calcium carbonate gives up carbon dioxide from about 680 to 800 °C, faster at 900 °C. The theoretical mass loss is 44%, so 100 kg of shell or limestone gives at most 56 kg of quicklime. Shells calcined at 900 °C for two hours still held some unburnt calcite (Journal of Ecological Engineering, calcination study, search summary) [VERIFY]. FEASTING Chapter 17 puts a pit fire at 650 to 850 °C. My inference is that a household fire makes poor, part-burnt lime and that real quicklime needs a village kiln at bright red heat for many hours [VERIFY]. Shells (oyster, mussel, freshwater mussel) are the source on shores, limestone and chalk inland.

Quicklime reacts with water, including tears and sweat, with heat. Slake lime into water, never water into lime, with goggles (FEASTING Chapter 6). Slaked lime causes serious eye damage and respiratory irritation (FEASTING VERIFICATIONS row T12).

4.2 Whitewash

Heritage NSW (2021) advises lime putty thinned with water to a thin cream, about 15 to 20% lime, mixed by eye. A materials study gives 15 to 20% calcium hydroxide by weight, the consistency of whole milk (MDPI Buildings 2022). Both read as search summaries, both agree. Tallow slaked into the lime (2 to 10 lb per bushel in an 1860 recipe) was common, but a National Park Service study found it reduced breathability, and lime and water alone proved most durable (Building Conservation, secondary). Three to five thin coats go on a damp wall.

Whether whitewash disinfects is untested. In the 1832 cholera, Oxford's Board of Health offered free lime for whitewashing (Oxfordshire Health Archives). Wet limewash is above pH 12 and will kill what it wets, but within days it is chalk, and its value is that it is clean and shows dirt [VERIFY].

4.3 Lime for latrines and excreta

Here the evidence is better and surprising. Trajano Gomes da Silva, Dias, Ebdon and Taylor (2018), at Brighton, compared hydrated lime at 10, 20 and 30% with 0.5% chlorine from three products, each added to simulated excreta at one part to ten, for 10 and 30 minutes. Lime at 30% reduced faecal coliforms by 4.75 log, enterococci by 4.16 and a viral model (somatic coliphage) by 2.85. The best chlorine achieved 2.90, 2.36 and 3.01. Lime held pH at about 12.9. Their purchased bleach measured only 1.58% available chlorine. Organic load consumes chlorine but not lime.

Eawag/Sandec defines lime treatment as pH above 11 held at least two hours (search summary) [VERIFY]. Ascaris and other helminth eggs survive much longer (secondary) [VERIFY], so limed excreta is safer to handle but not safe for crops. HY-04, not yet in the library, should hold latrine design.

Everyday guidance is looser. An American outhouse guide gives about a cup of hydrated lime over the pit when it smells and warns that excess slows decomposition (Inspectapedia, secondary). King County's emergency advice is dirt, lime, mulch or ash after each use, and a Ugandan arborloo guide a cup of dry ash after each use (King County, LeaPPS 2009, search summaries). Ash is the daily cover. Lime is for outbreaks, the sick-bucket and the dead.

5. Vinegar

Vinegar's reputation outruns its performance. Rutala, Barbee, Aguiar, Sobsey and Weber (2000) found vinegar gave less than 3 log reduction against Staphylococcus aureus and Escherichia coli in suspension, while undiluted household bleach gave more than 5.6 log, and only bleach and a phenolic inactivated poliovirus (abstract only). A secondary summary gives vinegar under 1 log against S. aureus at 30 seconds but over 5 log against Salmonella and Pseudomonas [VERIFY].

Against mycobacteria it does better. Cortesia and colleagues (2014) found 6% acetic acid for 30 minutes took Mycobacterium tuberculosis from about 10^8 to undetectable, though the M. abscessus group needed 10% (search summary). Greatorex and colleagues (2010) found 10% malt vinegar inactivated pandemic H1N1 influenza, but 1% vinegar did no better than hot water, while 1% of a commercial bleach and 0.01% washing-up liquid both worked.

On wounds, acetic acid acts on Pseudomonas aeruginosa: minimum inhibitory concentrations of 0.16 to 0.31% and eradication of mature biofilm within three hours in vitro (Halstead et al. 2015, search summary), and 0.5 to 5% cleared it from 14 of 16 burn and soft-tissue wounds within two weeks (Sloss et al. 1993, abstract only). A 2023 case report, seen only as a search summary, describes acetic acid dressings deepening an infant's graft donor sites [VERIFY]. Wounds are IN-07's subject.

Table vinegar is about 4 to 6% acetic acid [VERIFY], home vinegar weaker and unknown (FEASTING document 89 governs making it). For the dispensary vinegar is a laundry rinse (FEASTING's 1%), a descaler and a possible wound wash under IN-07. It is not the surface disinfectant, and it must never meet bleach, because acid releases chlorine gas (Rutala, Weber and HICPAC 2008).

6. Hypochlorite

6.1 What strength kills what

From the CDC guideline (Rutala, Weber and HICPAC 2008), MSF's cholera guideline (MSF, Appendix 15) and Lantagne's Ebola fact sheet (Lantagne 2014):

Strength	ppm	Use	Contact	Sources
0.05%	500	Hands, skin, laundry soak	Laundry up to 15 min	MSF, Lantagne, HY-01
0.1%	1,000	Make at this to have 500 after a month. M. tuberculosis	10 min	CDC
0.2%	2,000	Floors, surfaces, boots, dishes	15 min	MSF
0.5%	5,000	Objects, large blood spills after cleaning, C. difficile spores	10 to 15 min	Lantagne, CDC
1%	10,000	Stock solution only	none	MSF, Lantagne
2%	20,000	Bodies of the dead (cholera)	spray	MSF

The CDC records vegetative bacteria killed in seconds at about 5 ppm, 100 ppm killing S. aureus, Salmonella and Pseudomonas in under ten minutes, and 25 viruses inactivated by 200 ppm in ten minutes. It also records the limits: corrosive above about 500 ppm, inactivated by blood and dirt, weaker at high pH, and releasing chlorine gas with acid or ammonia. Clean first, then disinfect. MSF adds: plastic containers only, fresh daily, no rinse except stainless steel,

never mix chlorine products. Drinking water is HY-02's subject, wounds IN-07's. The 0.5% and stronger solutions are for objects, not skin [VERIFY].

6.2 Making the strengths from a known bleach

MSF's rule: parts of water to one part bleach = (bleach strength ÷ strength wanted) minus 1. For 0.2% that is 1 to 19 from 4% bleach and 1 to 12 from 2.6% (MSF). From 5% bleach it gives 1 to 9 for 0.5%, 1 to 24 for 0.2% and 1 to 99 for 0.05%, matching the CDC's 1:10 and 1:100 dilutions of 5.25 to 6.15% bleach (Rutala, Weber and HICPAC 2008). Two sources, consistent. MSF gives calcium hypochlorite (HTH, about 70%) at 15 g per 20 litres for 0.05% and 60 g per 20 litres for 0.2%.

Labels mislead. Lantagne found bleach off its label by an average of 35% (THRIVING library, HY-02), Trajano's bleach measured 1.58%, and Lantagne (2014) says to test every supply. Assume salvaged bleach is half its label unless tested [VERIFY].

6.3 Keeping

Iqbal, Lubeck-Schricker, Wells, Wolfe and Lantagne (2016) measured time to 90% of initial strength. HTH solutions and stabilised hypochlorite (pH above 11) kept over 30 days. Electrolytic hypochlorite at pH 9 kept 4 days at 0.05% and 6 days at 0.5%. Dichloroisocyanurate solution kept 2 days. Warmth, higher concentration and lower pH speeded decay. The CDC found a dilute solution in an opaque bottle lost 40 to 50% in a month but was stable 30 days in a closed brown bottle. Lantagne (2014) says unstabilised 1% loses half in four to six weeks, and to make solutions fresh daily.

6.4 Electrolytic hypochlorite: the record

Direct current through brine makes chlorine at one electrode and sodium hydroxide and hydrogen at the other, combining to hypochlorite. It is the one disinfectant a village can make from salt and a salvaged power source.

WATA devices. Antenna's WATA range, sold by Watalux, runs every model on brine of 25 g salt per litre for two hours, giving about 5 g of active chlorine per litre (0.5%). The Mini-WATA treats 0.5 litre with 12.5 g salt at 10 W, giving 2.5 g of chlorine. The Standard treats 2 litres at 36 W, the Plus 15 litres at 216 W, the Maxi 60 litres at 888 W. Unstabilised product is used within 24 hours, or stabilised for at least three months. A drop-count kit (WataTest) checks the product (Watalux 2022). My arithmetic: about 5 g salt and 8 Wh per gram of chlorine [VERIFY]. HY-02 gave 6 g/L and three hours for the Mini. The 2022 datasheet says 5 g/L and two hours, and HY-02 should be corrected.

Electro-Clean. Ashok Gadgil's group at Berkeley field-tested a very cheap generator in Mexico, India and Nigeria: two bare carbon gouging rods in a 1.5 litre bottle of 30 g/L brine, 5 V at 4 to 5 A for 90 minutes. Laboratory batches reached about 0.1% (962 ppm), field batches 259 to 640 ppm. Only about 17% of the current made chlorine. Anodes failed after about 45 hours, by thinning, with falling current as the warning. The product was acidified with vinegar to about pH 6, and the authors warn that below pH 4 chlorine is mainly dissolved gas, harmful to breathe. Stainless steel was rejected because it rusts in chloride. Capital cost was about 42 US dollars, running cost 9 to 15 US cents a litre (Naranjo-Soledad et al. 2024). By my arithmetic that is about three times the WATA's energy and six times its salt per gram of chlorine [VERIFY].

Keeping, disputed. Iqbal et al. (2016) found generated 0.5% product below 90% strength in six days. Naranjo-Soledad et al. (2024) found unacidified product lost under 5% in 34 days. Concentration, darkness and temperature may explain it [VERIFY]. Take the cautious figure.

Power. A Mini-WATA batch needs 20 Wh. A 12 V, 60 Ah car battery used to half capacity holds about 360 Wh, enough for about 45 g of chlorine, or 90 litres of 0.05% solution, and a 50 W panel in five hours of sun gives about

250 Wh [VERIFY]. That is within a village's reach if it has a purpose-made cell or electrodes that do not dissolve. Coated titanium cannot be made after the Fall. Carbon wears out. Iron rusts [VERIFY].

Failure. Chlorine gas comes off if the cell runs acid, if the product is over-acidified, or if it meets vinegar, acid or urine (Naranjo-Soledad et al. 2024, Rutala, Weber and HICPAC 2008). Hydrogen comes off in every run and burns in a closed space [VERIFY]. Lantagne (2014) warns that output varies, electrodes scale, and good salt and clean water are needed. No field reports of gas injury from small cells were found.

6.5 Testing chlorine

DPD tablets (used by Naranjo-Soledad et al. 2024 and HY-02) and drop-count kits (Watalux 2022) work until they run out. Iodometric titration with potassium iodide, thiosulfate and starch is the classic laboratory method [VERIFY], within reach of a district bench, but I read no field protocol. Without reagents there is no test. Smell shows chlorine is present, not its strength. Make it fresh and record each batch.

7. Heat, sun and drying

The UK Health and Safety Executive's standard for linen contaminated with blood-borne viruses is 65 °C for at least 10 minutes or 71 °C for at least 3 (HSE). Abney, Ijaz, McKinney and Gerba (2021) found temperatures above 60 °C needed for 99.9% reduction of many organisms, bacteria surviving up to 206 days on polyester and 90 on cotton, pinworm and Ascaris eggs surviving two to three weeks on cloth, regrowth during humid outdoor drying, and documented textile transmission of hepatitis A and B and Cryptosporidium. Orr et al. (2002) found hospital laundry standards adequate against enterococci (search summary). Norovirus on fabric needs at least 60 °C (secondary) [VERIFY].

Boiling exceeds every one of these thresholds. Ten minutes at a rolling boil clears the HSE standard with a wide margin [VERIFY]. FEASTING Chapter 17's bucking in hot lye combined heat and alkali. Where fuel is short, MSF's rule is a soak of up to 15 minutes in 0.05% chlorine, then a wash.

Sun is real but partial. Amichai, Grunwald, Davidovici and Shemer (2014) took 52 socks from tinea patients in Tel Aviv in June 2012. Three days in sun, at an average maximum of 28.2 °C, gave significantly more negative fungal cultures than indoor storage (chi-square for trend 37.4, $P < 0.0001$). Washing at 60 °C cleared Trichophyton rubrum and 30 °C did not. Sun does not sterilise. It serves washed cloth, bedding that cannot be boiled, and water by the SODIS method in HY-02.

Damp lets organisms survive and regrow (Abney et al. 2021). Dry fast in sun and wind.

Evidence grades

Practice	Grade	Tradition says	Record shows	Science infers
Lye from hardwood or banana ash	B	Hardwood makes lye, pine does not	Jefferson's yields, Babayemi's titrations	Potassium 3 to 10% of wood ash, banana far richer
Egg test	C	Floating egg shows strength	Used 1742 to 1830s, called inexact by Geoffroy	Crude density test, confounded by egg age and salts
Feather test	D	Feather dissolves in good lye	Craft sources only	Plausible, unmeasured
Tongue test of lye	X	Tongue tells strength	None	A caustic burn

Practice	Grade	Tradition says	Record shows	Science infers
Zap test of cured soap	D	Sting means lye	Craft sources	Crude free-alkali test
Causticising with lime	B	Lime strengthens lye	Geoffroy 1742, Mappae Clavicula	Standard chemistry
Soap from lye and fat	A for hand hygiene (HY-01), B for method	Ash and fat make soap	Two thousand years, Codex SAP values	Stoichiometric
Salting out	B	Salt hardens soap	Soap trade, 1841 newspaper	Partial ion exchange
Long cure as safety step	D	Unsafe until cured	Craft sources	Mostly water loss
Plant saponins	D	Soapwort cleans	HY-01	Weak surfactant
Lime on excreta	B	Lime sweetens the privy	One controlled laboratory trial	pH over 11 to 12 kills bacteria and viruses, not worm eggs
Whitewash as disinfectant	D	Cleanses the house	1832 cholera orders, no outcome	Alkaline only while wet
Vinegar on surfaces	X	Cleans and kills	Under 3 log on S. aureus, E. coli	Kills some Gram negatives and mycobacteria slowly
Acetic acid on Pseudomonas wounds	B	Vinegar dressings	Sloss 1993, Halstead 2015	Defer to IN-07
Hypochlorite 0.05 to 0.5%	A in vitro and practice, B in field	Chloride of lime since the 1820s [VERIFY]	CDC, MSF, Ebola response	Strength, time and a clean surface decide
Electrolytic chlorine	B	Bleach from salt	WATA, Electro-Clean	Works, keeps poorly, must be tested
Boiling cloth	B	Boil the sick linen	Laundry standards 65 to 71 °C	Exceeds every standard
Sun-drying cloth	B for fungi, C overall	Sun is the best disinfectant	Amichai 2014	Partial

Means ledger

Product	Hands	Hearth	Garden and still	Village dispensary (300)	District infirmary (3,000)	Pre-Fall hospital
Lye	Keep hardwood ash dry and apart	Barrel, rainwater, egg	Slaked lime, a scale	pH paper or titration, locked store	Titration, made or stored caustic soda	Bought hydroxides of stated purity

Product	Hands	Hearth	Garden and still	Village dispensary (300)	District infirmary (3,000)	Pre-Fall hospital
Soap	Ash or water and friction (HY-01)	Soft soap by egg and pot	Bar soap by salting out, SAP table	One soap house, named makers, phenolphthalein	Batch records, free-alkali titration	Liquid soap, chlorhexidine
Lime	Use ash instead	Barter lime, slake safely	Poor lime from small burns	Village kiln, whitewash, outbreak lime	Lime stores for epidemics and burials	Not used clinically
Vinegar	None	Laundry rinse	Vinegar of known strength	Wound wash only under IN-07	Acetic acid of known strength	1 to 5% acetic acid in burns units
Hypochlorite	None	Salvaged bleach, diluted by rule, half strength assumed	Same, with a job-by-strength chart	Electrolytic cell on panel or battery, DPD or drop test, fresh daily	Larger cell, iodometric titration, stabilised stock	Industrial bleach, alcohol, peroxide
Heat, sun	Sun-dry, separate the sick's cloth	Boil linen 10 min	Copper boiler, lines	Laundry routine, boil or 0.05% soak	71 °C laundry, autoclave	Industrial laundry

What each rung changes: the hearth has soap and boiled cloth, which is most of hygiene. The garden rung adds the scale and the SAP table, making soap predictable. The dispensary adds a disinfectant of known strength and a test, the basis on which MSF manages cholera and the Ebola response managed Ebola. The district adds titration and stabilised stock for when kits run out. The hospital adds products, not principles.

Harm test

Lye. Harms by deep skin burns, blinding splashes and swallowed burns with later stricture. The errors are lye in a drinking vessel, soap made where children are, water poured onto solid caustic, tasting, and induced vomiting (Ekpe and Ette 2012). Children must never be near it, and no one handles it without eye protection. Warning signs: a slippery feel on skin (the skin is saponifying), stinging. After swallowing: drooling, pain on swallowing, refusal to drink, hoarseness, noisy breathing. What to do: brush off solids, water for 15 to 20 minutes with clothes removed under the water, the eye 15 to 30 minutes held open. If swallowed, no vomiting, no neutralising, nothing by mouth if drooling or breathing is noisy [VERIFY]. Cases: Uyo, Accra, Goderich, Philadelphia.

Soap. Free alkali causes dermatitis, excess fat makes rancid soap, and fresh batter is as caustic as lye. Errors: unknown lye strength, commercial KOH treated as pure, potash treated as KOH. Signs: burning hands, a pink phenolphthalein test. Stop, rebatch with fat, or use for floors.

Lime. Quicklime burns skin and eyes, worse when wet, slakes violently, and its dust irritates lungs. Excess lime stalls a latrine. Brush off dry lime, then water (Gnaneswaran et al. 2015). Children never near quicklime.

Vinegar. Harms by false reassurance, by deepening wounds if misused, and by chlorine gas if mixed with bleach.

Hypochlorite. Harms by chlorine gas when mixed with acid or ammonia or made in acid (cough, choking, chest tightness, sometimes delayed lung injury) [VERIFY], by burns from strong solutions, by corroding instruments, and

by failing when weak, old or used on dirt. Errors: mixing products, 0.5% on hands, a week's unstabilised stock, trusting labels, acidifying without a pH meter. People with asthma are most at risk [VERIFY]. Signs: a swimming-pool smell in a closed room, coughing, stinging eyes. Leave, ventilate, rest, water for eyes and skin.

Electrolysis. Hydrogen ignition, shock from mains-derived supplies, short-circuited batteries, chlorine gas. Use only battery or low-voltage DC [VERIFY].

Heat. Scalds from boiling laundry and fire. Keep children away from the copper.

Red flags

- **A child who swallowed lye and drools, cannot swallow or breathes noisily.** Without endoscopy, dilatation and surgery, half of such children in Uyo developed strictures (Ekpe and Ette 2012). Nothing by mouth, sit upright, protect the airway, give pain relief, try fluids slowly after the first days. A child who chokes on solids weeks later has a stricture, and thin gruel and milk may keep them alive [VERIFY]. Honestly: some recover, many need what the village cannot give, and prevention is the only true remedy.
- **An eye splashed with lye or lime that is white, cloudy or numb after irrigation.** Sight may be lost. Keep irrigating, cover, relieve pain, do not rub.
- **A skin burn that turns white, leathery or numb over two to three days.** Now full thickness (Gnaneswaran et al. 2015). Treat as a deep burn under the WO series.
- **Breathlessness or blue lips after chlorine gas, worse after some hours.** Lung injury. Upright, rest, warmth, oxygen if any exists, and watch through the night.
- **An outbreak of watery diarrhoea or jaundice in spite of soap and chlorine.** The barrier has failed. Look for the gap (water, latrine, carers' hands, the dead), move to MSF's cholera standards, and send for help if any exists.

The case against

Against home lye and soap. The FEASTING Broker (Chapter 17) already said the two lye documents behind that chapter rest on hobby blogs, and this research confirms that craft soap sources repeat each other and say little about the child who drinks the lye. The surgical record from Uyo, Accra and Goderich argues that household soap-making without storage control harms children more than soap helps them. HY-01's sources show that washing at all, with friction, matters more than the agent: Hoque found ash and mud about as good as soap, and Paludan-Müller and colleagues' Cochrane rapid review (2020) rated ash as uncertain rather than worse (THRIVING library, HY-01). A village could use ash and water for hands and eat its fat. My view is that soap is still worth making for laundry and the sickroom, but in one place, by trained people.

Against vinegar. William Rutala and David Weber, whose work underlies the CDC guidance, found vinegar weaker than every commercial disinfectant tested (Rutala et al. 2000).

Against electrolytic bleach. Daniele Lantagne, who led much of the field research on emergency chlorine, cautions that generator output varies and must be tested, and her group found generated hypochlorite kept four to six days (Lantagne 2014, Iqbal et al. 2016). Gadgil's group reports 17% efficiency and electrodes that failed in 45 hours (Naranjo-Soledad et al. 2024). A village's one panel may be needed for light or a vaccine fridge. Electrolysis earns its place where faecal outbreaks threaten, salt and power exist, and someone can test.

Against lime. The strong study was laboratory work on simulated excreta, worm eggs survive, lime blinds, and kilns burn fuel.

Against chlorine at all. Bleach at a third of its label (Trajano) and labels off by a third on average (Lantagne) make salvaged chlorine a gamble, and it fails on dirt.

Against the romance of the hospital. Its rules (clean, then disinfect at stated strength for stated time, with heat where possible) need nothing a village lacks except reagents to test chlorine.

10-line summary

1. Hardwood or banana ash gives potash lye, pine gives little, and the egg test is a go or no-go measure its 1742 recorder called inexact.
2. Soap needs about 135 to 145 g sodium hydroxide or 190 to 200 g pure potassium hydroxide per kg of common fats, a third more for coconut (Codex).
3. FEASTING's "200 g potash" is pure KOH, potash proper does a fifth less per gram, and ash lye is measured by egg and volume or by titration.
4. Ash lye makes soft soap, salt partly hardens it, and a kilogram of fat makes about 1.3 kg of bar or 2 kg of soft soap.
5. In Uyo, Nigeria, 87.5% of child caustic ingestions came from homes making soap, and half the children developed strictures.
6. Alkali burns need water at once for 15 to 30 minutes, no acid, dry lime brushed off first.
7. Hypochlorite at 0.05% for hands and laundry, 0.2% for surfaces and 0.5% for spills and objects, after cleaning, for 10 to 15 minutes.
8. Electrolytic chlorine from 25 g/L brine gives about 0.5% in two hours, keeps under a week unless stabilised, and must be tested.
9. A 30% slaked lime suspension beat 0.5% chlorine on simulated excreta by about 2 logs against faecal coliforms.
10. Vinegar is a weak disinfectant, boiling cloth exceeds every laundry standard, and sun is partial but measured.

Open questions

- Real yield and strength of lye from Brandenburg beech, oak, birch and pine ash. No measurements found.
- The specific gravity of egg-float lye, and how much egg age shifts it.
- How fast ash-lye soft soap reaches a safe free-alkali level.
- Whether generated hypochlorite keeps 6 days (Iqbal) or 34 days (Naranjo-Soledad), and why.
- An electrode a post-Fall village can make or salvage that lasts.
- Hydrogen and chlorine released by small open cells in a closed room.
- What a small village kiln reaches and what fraction of shell it burns. FEASTING has no lime-burning document and I found no primary source.
- Whether fresh limewash measurably reduces surface bacteria.
- The tongue and zap tests (FEASTING T10).
- The 1688 Marseille edict, the "72%" rule, the soap tax rates and the Babylonian recipe, found only in secondary sources.

Sources to read in full

1. Rutala, Weber and HICPAC, CDC Guideline for Disinfection and Sterilization, 2008, updated 2019, chemical disinfectants (reference 24).
2. MSF cholera guideline, Appendix 15 (reference 18).
3. Lantagne 2014 and Iqbal et al. 2016 (references 15, 12).
4. Naranjo-Soledad et al. 2024 (reference 19).
5. Trajano Gomes da Silva et al. 2018 (reference 27).
6. Ekpe and Ette 2012 (reference 7).
7. Gnaneswaran et al. 2015 (reference 10).
8. Dunn, Scientific Soapmaking, 2010, not read here, and his Caveman Chemistry chapter (reference 6).

9. Abney et al. 2021 (reference 1).
10. Geoffroy 1742 (reference 9).

At the bedside after the Fall

Household. Soft soap from tallow or lard and ash lye, made away from children, the lye in a marked vessel that is not a bottle or cup. Boiled linen for the sick, sun for bedding, ash on the latrine. Needs: dry hardwood ash, rainwater, a barrel, fresh eggs, a pot, a long paddle, goggles, gloves, a bucket of water at hand, and 10 to 15 kg of fat a year for four. First failure: a weak lye and a greasy soap, then boiling lye down in the kitchen with children present.

Village of 300. One soap house with two trained makers, a scale, the SAP table, salt, and phenolphthalein or pH paper. A dispensary laundry that boils or soaks in 0.05% chlorine. A 0.2% surface disinfectant from bleach or an electrolytic cell. Hydrated lime for outbreaks, the sick-bucket and the dead. A batch book (date, quantities, test, maker). Needs: about 45 kg of fat a year for dispensary soap and 2 to 5 kg of salt a month for a cell [VERIFY], a panel and battery, test reagents, labelled plastic containers. First failure: chlorine that has lost strength and was never tested, or a child who drinks lye from the soap house.

District of 3,000. A soap works, a lime kiln, a larger cell or stocks of HTH, titration for chlorine and alkali, a laundry at 71 °C or boiling, and someone who trains village makers and checks their batches. Needs a burette, indicators, reagents, salt and fuel. First failure: reagents run out and testing quietly stops.

Protocols

Protocol 1. Ash lye (FEASTING Chapter 17, Practical Action)

1. Collect dry hardwood ash (beech, oak, ash, maple, fruit woods) or banana leaf, stem or peel ash. Keep pine ash apart. Sieve out charcoal.
2. Goggles, gloves, children and animals away, a full bucket of clean water at hand.
3. Barrel or bucket with a hole near the base, on blocks. Line with stones, then sticks, then a hand's depth of packed straw. Fill with ash.
4. Optional, for stronger lye: mix in slaked lime at 2 to 5% of the ash's weight (FEASTING), with a dust mask.
5. Pour rainwater on slowly. Hot water is faster.
6. Stand 12 to 24 hours (Practical Action) to two days (FEASTING). Collect in glass, enamel, stainless steel or plastic, never aluminium.
7. Test with a fresh egg. Floating with a coin-sized patch: strong enough. Sinking: run through fresh ash again or boil down outdoors.
8. Expect about a quarter bucket of lye per bucket of ash.
9. Label LYE with a skull or cross, store high or locked, never in a drinking bottle.

Protocol 2. Soft potash soap (FEASTING Chapters 9 and 17, NPS Fort Scott)

1. Render and strain the fat (FEASTING Chapter 9). Weigh it.
2. Per 1 kg tallow or lard: 3 to 4 litres egg-floating ash lye (FEASTING) or about 4 litres (Fort Scott). With bought pure KOH instead: 185 g in about 500 ml water, or about 205 g of 90% commercial KOH [VERIFY].
3. Fat at 40 to 45 °C. Warm ash lye separately, outdoors.
4. Add lye to fat slowly, stirring with wood. With ash lye, simmer gently, stirring, until a smooth, clear paste with no oily layer, which takes hours [VERIFY].
5. Test: a spoonful dissolves clear in hot water and lathers without grease. If greasy, add lye a little at a time. If deep pink with phenolphthalein in alcohol, add a little fat.
6. Store in a covered crock. Use 50 g per 10 litres of wash water (FEASTING).
7. Expect about 2 kg per kg of fat [VERIFY].

Protocol 3. Hard soap by salting out (FEASTING Chapter 17, 1841 newspaper, encyclopedia account)

1. Make soft soap by Protocol 2, hot.
2. While boiling, stir in salt, about a quarter of the soap's weight.
3. Boil until curds float on watery lye and a ladleful sets hard in cold water.
4. Cool, lift off the curd. Pour the spent lye into a latrine or on bare ground away from water and children.
5. Mould, cut when firm, dry on racks a few days, ideally a month.
6. Expect about 1.2 to 1.3 kg per kg of fat [VERIFY].

Protocol 4. Bar soap from bought caustic soda (FEASTING Chapter 9, Codex)

1. Goggles, gloves, sleeves, ventilation, children out, water ready.
2. Per 1 kg tallow or lard: 130 g sodium hydroxide (FEASTING's 140 g less a 5% margin). Olive, rapeseed or sunflower oil: 125 to 130 g. Coconut: 168 g [VERIFY].
3. Add the caustic slowly to about 300 to 350 ml cold water, never water onto caustic. Cool to about 40 °C [VERIFY].
4. Fat at 40 to 45 °C. Pour lye into fat, stir to a custard-like trace.
5. Mould, cover, cut after 1 to 2 days.
6. Cure four weeks if possible. Test with phenolphthalein in alcohol or pH paper (9 to 10 in water) before use on skin.
7. Expect about 1.25 to 1.35 kg per kg of fat [VERIFY].

Protocol 5. Chlorine from household bleach (MSF Appendix 15, CDC)

1. Read the label strength. Assume half if old or untested.
2. Plastic vessels with lids, labelled with strength and date.
3. Parts water per part bleach = (bleach % ÷ % wanted) minus 1.
4. From 5% bleach: 0.5% is 1 to 9, 0.2% is 1 to 24, 0.05% is 1 to 99.
5. Clean with soap and water first. Apply, leave 10 to 15 minutes. Rinse only stainless steel.
6. Laundry: soak in 0.05% no more than 15 minutes, then wash and sun-dry.
7. Make fresh daily. Never mix with vinegar, acid, ammonia, urine or another chlorine product.

Protocol 6. Operating a manufactured electrolytic chlorinator (Watalux 2022, Lantagne 2014, Iqbal et al. 2016)

1. Only a purpose-made cell, following its own instructions, on battery or low-voltage DC.
2. Clean water and pure, preferably non-iodised salt, at the maker's strength (25 g per litre for WATA).
3. Open container, ventilated place, no flame nearby. Never add acid or vinegar.
4. Run the maker's time (two hours for WATA, about 0.5%).
5. Test each batch (drop kit or DPD). If untestable, use the same day only: neat for objects, 1 to 9 for 0.05%.
6. Opaque closed plastic bottle, cool and dark, dated. Use within 24 hours unless stabilised, never beyond 4 to 6 days.
7. Descale electrodes as instructed. Record batch, time, test and operator.

Protocol 7. Lime for excreta (Trajano Gomes da Silva et al. 2018, Inspectapedia, Eawag)

1. Hydrated lime, never quicklime. Goggles and mask.
2. Household latrine: a cup of dry ash after each use, lime only for smell, about a cup over the pit.
3. Outbreak buckets: a slurry of about 3 parts hydrated lime to 10 of water (30%), one part to about ten of excreta, mixed, held at least 30 minutes and ideally two hours before emptying into a latrine [VERIFY].
4. Limed excreta never on food crops.

Protocol 8. Limewash (Heritage NSW 2021, MDPI Buildings 2022)

1. Wet the wall the day before and again before painting.
2. Lime putty or hydrated lime in water to whole-milk consistency, 15 to 20% lime by weight, sieved. Goggles.
3. Three to five thin coats, each dried slowly. Renew yearly in the sickroom.

Protocol 9. Sickroom laundry (HSE, Abney et al. 2021, MSF, Amichai et al. 2014)

1. Gloves. Fold soiled linen inward into its own bucket. Rinse solids into the latrine.
2. Boil with soap 10 minutes at a rolling boil, or soak in 0.05% chlorine up to 15 minutes then wash, or 65 °C for 10 minutes or 71 °C for 3 by thermometer.
3. Dry fast in sun and wind. Never leave damp in heaps.
4. Bedding that cannot be boiled: three days of sun, turned.

Protocol 10. The dispensary's weekly strength round

1. Lye: fresh egg, pH paper 13 or above, or titration.
2. Soap: clean lather, phenolphthalein in alcohol not deep pink, 1% solution about pH 9 to 10.
3. Chlorine: DPD or drop kit. No reagent: remake daily.
4. Laundry: thermometer in the boiler.
5. Write every result in the batch book.

Numbers to carry

1. **135 to 145 g caustic soda, or 190 to 200 g pure caustic potash, per kg of fat.** Use 130 and 185 for a margin.
2. **About 4 litres of egg-floating ash lye per kg of fat.**
3. **1 kg of fat makes about 1.3 kg of bar soap or 2 kg of soft soap.** [VERIFY]
4. **Chlorine 0.05% hands and laundry, 0.2% surfaces, 0.5% spills and objects, after cleaning, 10 to 15 minutes.**
5. **From 5% bleach: 1 to 99, 1 to 24, 1 to 9.**
6. **Electrolytic chlorine: 25 g salt per litre, 2 hours, about 0.5%, use within 24 hours unless stabilised.**
7. **Lye or lime in the eye: water at once, 15 to 30 minutes. No acid.**
8. **Laundry: boil 10 minutes, or 71 °C for 3, or 65 °C for 10.**
9. **Excreta: 30% lime slurry, 1 to 10, pH over 11 for 2 hours.**
10. **Never chlorine with acid or urine, lye in a drinking bottle, or water onto lye or quicklime.**

References

1. Abney SE, Ijaz MK, McKinney J, Gerba CP. Laundry hygiene and odor control: state of the science. Applied and Environmental Microbiology 2021, 87:e03002-20. https://pmc.ncbi.nlm.nih.gov/articles/PMC8231443/
2. Amichai B, Grunwald MH, Davidovici B, Shemer A. "Sunlight is said to be the best of disinfectants": the efficacy of sun exposure for reducing fungal contamination in used clothes. Israel Medical Association Journal 2014, 16:431 to 433. https://ima.org.il/filesupload/imaj/0/87/43880.pdf
3. Babayemi JO, Dauda KT, Kayode AAA, Nwude DO, Ajiboye JA, Essien ER, Abiona OO. Determination of potash alkali and metal contents of ashes obtained from peels of some varieties of Nigeria grown Musa species. BioResources 2010, 5(3):1384 to 1392. https://bioresources.cnr.ncsu.edu/BioRes_05/BioRes_05_3_1384_Babayemi_DNAEA_Deter_Potash_Ash_Peels_Musa_S
4. Codex Alimentarius Commission. Standard for Named Vegetable Oils, CXS 210-1999. FAO and WHO 1999. http://www.fao.org/4/y2774e/y2774e04.htm (Codex 1999a)

5. Codex Alimentarius Commission. Standard for Named Animal Fats, CXS 211-1999. FAO and WHO 1999. https://www.fao.org/4/y2774e/y2774e05.htm (Codex 1999b)
6. Dunn KM. Caveman Chemistry, chapter on soap. 2003, online edition. https://www.cavemanchemistry.com/cavebook/chsoap.html (Dunn's Scientific Soapmaking, 2010, was not read. Statements attributed to it come from forum summaries.)
7. Ekpe EE, Ette V. Morbidity and mortality of caustic ingestion in rural children: experience in a new cardiothoracic surgery unit in Nigeria. ISRN Pediatrics 2012, 2012:210632. https://pmc.ncbi.nlm.nih.gov/articles/PMC3384939
8. EMERGENCY. Paediatric surgery for caustic soda ingestion, Goderich, Sierra Leone. EMERGENCY NGO web page, about 2022. https://en.emergency.it/?p=27584
9. Geoffroy CJ. Method of making soap-lees and hard soap, for medicinal uses (letter to David Hartley). Philosophical Transactions of the Royal Society 1742, 42. OCR text at https://jimclifford.ca/philosophical-transactions-ocr-1665-1869/articles/jstor-104148/
10. Gnaneswaran N, Perera E, Perera M, Sawhney R. Cutaneous chemical burns: assessment and early management. Australian Family Physician 2015, 44(3):135 to 139. https://www.racgp.org.au/getattachment/13b3fe18-3be9-4c0f-b126-45f0af3bcfcd/Cutaneous-chemical-burns-assessment-and-early-mana.aspx
11. Greatorex JS, Page RF, Curran MD, et al. Effectiveness of common household cleaning agents in reducing the viability of human influenza A/H1N1. PLoS One 2010, 5(2):e8987. https://pmc.ncbi.nlm.nih.gov/articles/PMC2813869/
12. Iqbal Q, Lubeck-Schricker M, Wells E, Wolfe MK, Lantagne D. Shelf-life of chlorine solutions recommended in Ebola virus disease response. PLoS One 2016, 11(5):e0156136. https://pmc.ncbi.nlm.nih.gov/articles/PMC4887112
13. Jefferson T. Farm Book, page 117 (potash and pearl ash). Massachusetts Historical Society and Monticello digital edition. https://dasfam.monticello.org/documents/farmbook_page117.html
14. Kuckelkorn R, Schrage N, Keller G, Redbrake C. Emergency treatment of chemical and thermal eye burns. Acta Ophthalmologica Scandinavica 2002, 80:4 to 10. https://read.qxmd.com/read/11906296/emergency-treatment-of-chemical-and-thermal-eye-burns (abstract only)
15. Lantagne D. Methods to make chlorine solution in Ebola emergencies, fact sheet revision 1.1, 28 October 2014. Tufts University, distributed by FHI 360 WASHplus. https://washplusblog.fhi360.org/drinkingwaterupdates/wp-content/uploads/2014/10/lantagne-make_chlorine2014.pdf
16. Leonard LG, Scheulen JJ, Munster AM. Chemical burns: effect of prompt first aid. Journal of Trauma 1982, 22(5):420 to 423. https://pubmed.ncbi.nlm.nih.gov/7077702/ (abstract only, via Europe PMC)
17. Hydrite Chemical Co. Caustic 50 (sodium hydroxide solution) safety data sheet, 2022. https://labelsds.com/images/user_uploads/Hydrite%20Caustic%2050%20SDS%203-11-22.pdf (search summary only), with EyeWiki (American Academy of Ophthalmology), Chemical (alkali and acid) injury of the conjunctiva and cornea, https://eyewiki.org/Chemical_%28Alkali_and_Acid%29_Injury_of_the_Conjunctiva_and_Cornea (search summary only)
18. Médecins Sans Frontières. Management of a cholera epidemic, Appendix 15: preparation and use of chlorine solutions. MSF Medical Guidelines. https://medicalguidelines.msf.org/en/node/926
19. Naranjo-Soledad A, Smesrud L, Bandaru SRS, Hernandez D, Mehare M, Mahmoud S, Matange V, Rao B, Chandana N, Balcom P, Omole DO, Álvarez-Mejía C, López-Ramírez V, Gadgil A. Low-cost, local production of a safe and effective disinfectant for resource-constrained communities. PLOS Global Public Health 2024, 4(6):e0002213. https://pmc.ncbi.nlm.nih.gov/articles/PMC11198905/
20. National Park Service, Fort Scott National Historic Site. The laundress, teaching material. https://www.nps.gov/fosc/forteachers/laundress7.htm (search summary only)

21. Practical Action. Soap making, technical brief KnO-100357. https://samplecontents.library.ph/en-practical_action/Manufacturing,%20handicraft,%20process%20industries/KnO-100357_Soapmaking/page2.html (page 2 read, hot-process figures from a search snippet)
22. Oxfordshire Health Archives. Cholera in Oxfordshire, 1832, including the Board of Health notice on lime for whitewashing. https://oxfordshirehealtharchives.nhs.uk/cholera/
23. myjoyonline, reporting the Daily Graphic. Caustic soda ingestion in children, National Cardiothoracic Centre, Accra, 2008. https://www.myjoyonline.com/?p=10013347 (newspaper report, secondary)
24. Rutala WA, Weber DJ, Healthcare Infection Control Practices Advisory Committee. Guideline for Disinfection and Sterilization in Healthcare Facilities, 2008, updated 2019: Chemical disinfectants. Centers for Disease Control and Prevention. https://www.cdc.gov/infection-control/hcp/disinfection-sterilization/chemical-disinfectants.html
25. Rutala WA, Barbee SL, Aguiar NC, Sobsey MD, Weber DJ. Antimicrobial activity of home disinfectants and natural products against potential human pathogens. Infection Control and Hospital Epidemiology 2000, 21(1):33 to 38. https://pubmed.ncbi.nlm.nih.gov/10656352/ (abstract only)
26. Sloss JM, Cumberland N, Milner SM. Acetic acid used for the elimination of Pseudomonas aeruginosa from burn and soft tissue wounds. Journal of the Royal Army Medical Corps 1993, 139(2):49 to 51. https://pubmed.ncbi.nlm.nih.gov/8355236/ (abstract only)
27. Trajano Gomes da Silva D, Dias E, Ebdon J, Taylor H. Assessment of recommended approaches for containment and safe handling of human excreta in emergency settings. PLoS One 2018, 13(7):e0201344. https://pmc.ncbi.nlm.nih.gov/articles/PMC6062132/
28. Watalux (Antenna Foundation). Fiche technique des appareils WATA, 2022. https://www.pseau.org/outils/ouvrages/watalux_fiche_technique_des_appareils_wata_2022.pdf
29. Cortesia C, Vilchèze C, Bernut A, et al. Acetic acid, the active component of vinegar, is an effective tuberculocidal disinfectant. mBio 2014, 5(2):e00013-14. https://doi.org/10.1128/mBio.00013-14 (search summary only)
30. Halstead FD, Rauf M, Moiemen NS, et al. The antibacterial activity of acetic acid against biofilm-producing pathogens of relevance to burns patients. PLoS One 2015, 10(9):e0136190. https://doi.org/10.1371/journal.pone.0136190 (search summary only)
31. Health and Safety Executive. Laundry treatments for blood-borne viruses. HSE web page. https://hse.gov.uk/biosafety/blood-borne-viruses/laundry-treatments.htm (search summary only)
32. Orr KE, Holliday MG, Jones AL, Robson I, Perry JD. Survival of enterococci during hospital laundry processing. Journal of Hospital Infection 2002. https://researchportal.northumbria.ac.uk/en/publications/survival-of-enterococci-during-hospital-laundry-processing/ (search summary only, volume and pages not checked [VERIFY])
33. Tallis J. Tallis's history and description of the Crystal Palace and the Exhibition of the World's Industry in 1851, volume 2. London 1851. https://digi.ub.uni-heidelberg.de/diglit/tallis1851bd2/0207 (soap consumption figures, search summary only)
34. Grace's Guide to British Industrial History. 1880 British Soap Industry. https://gracesguide.co.uk/1880_British_Soap_Industry (secondary)
35. Wikipedia. Wood ash. https://en.wikipedia.org/wiki/Wood_ash (secondary), with Forest Research, The use of ash in forestry, 2022, https://cdn.forestresearch.gov.uk/2022/02/use_of_ash_in_forestry.pdf (search summary only)
36. Wikipedia. Hard soap. https://en.wikipedia.org/wiki/Hard_soap (secondary, quoting an older encyclopedia)
37. Wikipedia. Aleppo soap, Soap, and Nicolas Leblanc. https://en.wikipedia.com/wiki/Aleppo_soap, https://en.wikipedia.com/wiki/Soap, https://en.wikipedia.org/wiki/Nicolas_Leblanc (secondary)
38. Mütter Museum. Caution, progress: Chevalier Jackson and the Federal Caustic Poison Act. College of Physicians of Philadelphia. https://muttermuseum.org/stories/posts/caution-progress-chevalier-jackson-and-federal-caustic-poison-act (search summary only)

39. University of South Carolina Libraries, historic newspapers. Issue of 26 May 1841, on hardening soft soap with salt. https://historicnewspapers.sc.edu/lccn/sn85042795/1841-05-26/ed-2/seq-2/ (search summary only)
40. Heritage NSW. Heritage maintenance: limewash, 2021. https://www.environment.nsw.gov.au/sites/default/files/heritage-maintenance-limewash-2021.pdf (search summary only), with Building Conservation, Awash with colour, https://buildingconservation.com/articles/decorative-protective-limewash/decorative-protective-limewash.htm (secondary), and MDPI Buildings 2022, 12(4):402, https://www.mdpi.com/2075-5309/12/4/402 (search summary only)
41. Inspectapedia. Outhouse, privy or dunny construction and maintenance guide. https://inspectapedia.com/septic/Outhouse_Latrine.htm (secondary), with King County Public Health, Emergency toilets, https://kingcounty.gov/en/dept/dph/health-safety/safety-injury-prevention/emergency-preparedness/personal-preparedness/emergency-toilets, and LeaPPS, Guide on operations, household arborloo and fossa alterna, 2009, https://www.ircwash.org/sites/default/files/leapps_information_2009_guide_on_operations_household_arborloo-fossa_alterna.pdf (both search summaries only)
42. Eawag/Sandec. Lime treatment, emergency sanitation technology sheet. https://eawag.ch/fileadmin/Domain1/Abteilungen/sandec/schwerpunkte/sesp/Emergencies/lime_treatment.pdf (link failed, content from search summary)
43. Journal of Ecological Engineering. Analysis of optimum temperature and calcination time in the production of CaO using shells. https://www.jeeng.net/Analysis-of-Optimum-Temperature-and-Calcination-Time-in-the-Production-of-CaO-Using,135316,0,1.html (search summary only)
44. Retrospective study of alkali burns of the eye (Australia, 1983). https://read.qxmd.com/read/6421269/retrospective-study-of-alkali-burns-of-the-eye (search summary only)
45. FEASTING after the FALL, manuscript Chapters 6, 8, 9, 12 and 17 and VERIFICATIONS.md (rows B19, T1, T10, T12). THRIVING after the FALL, Book Three, unpublished, Shared drive T/PROJECTS/THRIVING/FEASTING AFTER THE FALL/MANUSCRIPT/.
46. THRIVING library, HY-01, Clean hands (library report, 2026), citing Hoque 1991 and 1995, Paludan-Müller et al. 2020, Shithi 2024 and WHO soap quantities.
47. THRIVING library, HY-02, Safe water (library report, 2026), citing Lantagne 2009 on bleach label strength and the SODIS method.